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ABSTRACT

Cooperative education is a learning strategy that fits very well with basic laws of learning. In fact, several basic important learning processes are far better adapted to the cooperative education strategy than to methods that lean entirely on classroom instruction. For instance, cooperative education affords more opportunities for reinforcement, practice, and overlearning. In addition, co-op settings enjoy the natural advantage of any individualized learning setting in assuring that it progresses and pauses in synchrony with the student's attentiveness. Because the concrete experiences occurring in co-op assignments provide meaningfulness to concepts, they can be grasped more fully and thoroughly. Finally, models in co-op jobs provide extensive demonstrations of appropriate behavior patterns in a variety of real situations that are rewarded or punished appropriately. While additional examination of learning processes would doubtlessly reveal other important advantages of the co-op method, these should suffice to challenge faculty, particularly co-op educators, to explore and develop more fully the relationships between learning objectives of co-op assignments and those of students' major disciplines. (MN)

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COOPERATIVE EDUCATION IS A SUPERIOR STRATEGY FOR USING BASIC LEARNING PROCESSES

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Introduction

I. Law of Effect (Reinforcement)

II. Law of Exercise (Practice)

III. Law of Readiness (Attentiveness)

IV. Stimulus Association and Cognitive Processes

V. Observational/Initative Learning Processes (Modeling)

VI. Some Implications

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INTRODUCTION

Cooperative Education is a learning strategy which fits very well with basic laws of learning. To demonstrate this; first, a very brief account of the historical background of learning theory will be given. Then, basic learning processes will be discussed, and the relationship of these processes to the co-op method will be made clear. Finally, important implications and recommendations for purposes and designs of Cooperative Education will be drawn.

This report is somewhat more theoretically oriented than would be encountered normally in Cooperative Education, probably because co-op practitioners by their nature are action and application oriented. However, it is important to develop and have available, the following theoretical analysis in order to respond to skepticism frequently expressed in academia. Additional helpful references are provided at the end of this report, particularly the article by Jabs, et al (1977).

Of course, theorizing about how learning occurs can be traced back to the ancient philosophers. But modern research goes back about a hundred years or so. As recently as 50 to 60 years ago theorizing centered around what one single primary process might be sufficient to account for learning. And just 20 to 30 years ago it appeared that most learning theorists agreed upon two primary processes, although there were a few dissenters who would add a few alternative processes of their own.

We still view much of learning in terms of these two primary learning processes. One of these is called Instrumental or Operant learning and it involves learning that occurs so that we can earn rewards. That is, we learn to do certain things because they are instrumental to us in getting what we want. A considerable degree of actual awareness on the part of the learner is implied in this kind of learning.

Less awareness is implied in the other primary form of learning which is usually called Classical Conditioning or Pavlovian Conditioning, after I. P. Pavlov who discovered it. This kind of conditioning involves how mental associations are acquired between different stimuli, or concepts when they occur together frequently. However, there are also other processes involved in learning which will also be briefly discussed.

I. THE LAW OF EFFECT (Reinforcement)

Thorndike (1932) explained Instrumental Learning by formulating several laws which seemed consistently to apply. His first law, the Law of Effect, stated that

"If a response is followed by a (reward or reinforcer) the bond between the (preceding) stimulus and the response (the S---R bond) is strengthened..."

This law is shown schematically in Figure 1. Three elements are involved: (1) a stimulus event (or a configuration of several stimuli), (2) a response performed by the subject, and (3) another S, but this latter S is a stimulus of a special kind, a reward or reinforcer stimulus. In simple terms, if the subject performs the "right" R, then a reinforcer will occur and the effect of the reinforcer is to strengthen the S---R bond (association). As a result, for any future occurrence of the same stimulus, there will be an even greater tendency to perform the same response.

For example, you are driving your car down the street and you pull up to an intersection. You watch the traffic control light until it turns green, and then you proceed onward toward your goal. You don't go when the light is red because you have learned that there is a high risk of being punished or hurt for that behavior and you may not progress toward your reward.

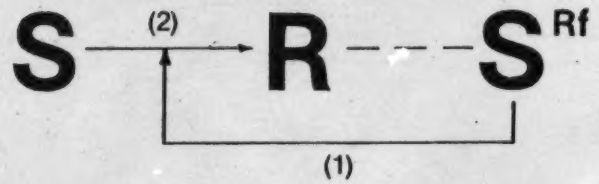
What are Reinforcers? Thorndike actually called them "satisfiers" because they satisfy needs or motives that we have. They include satisfiers for such primary needs as food, water, air, sleep, sex, etc. But we are also motivated for, or learn at an early age, to be motived for achievement, mastery, control, acceptance, approval, etc. So, in addition to M & M's and money serving as reinforcers, simply getting feedback from others that we are doing well also works like a reinforcer.

This reinforcement effect is so basic to learning theories that it has been incorporated as an essential part of the most common definition of learning (Kimble, 1961), which is that: "Learning is a relatively permanent change in a behavior tendency as a result of reinforced practice." Learning can occur without reinforcement, but the result is very weak and transitory. This is called Latent Learning.

In view of the Law of Effect, it is revealing to compare the classroom setting to the co-op setting. The classroom setting involves the student in a passive role, not performing responses but listening, and trying to learn as a latent learner with few reinforcements. The co-op setting requires the student to actively respond in appropriate ways to appropriate stimuli, and there is rich availability of reinforcers in several forms: money earned for working, achievement satisfaction from jobs well done, and frequent direct personal feedback from co-workers and the supervisor.

FIGURE 1

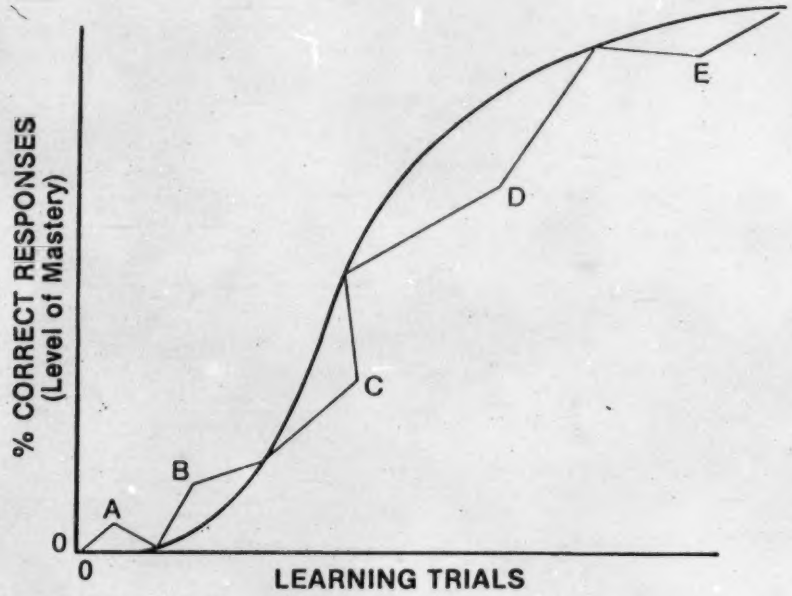
LAW OF EFFECT (Reinforcement Effect)



The occurrence of the S^{Rf} stimulus/event following an R in the presence of S has the effect (1) of strengthening the S-R bond (2), thus increasing the tendency for the same R to recur in the presence of the S.

FIGURE 2

TYPICAL LEARNING CURVE



A: Threshold Phase
B: Rapid Acquisition (Positively accelerated) Phase
C: Relatively Steady Gain (0 acceleration) Phase
D: Slowed Acquisition (Negatively accelerated) Phase
E: Approaching Asymptotal Performance level

There are reinforcers also available in the classroom, but time prevents them from being given frequently on a direct personal basis by the teacher. The only other available reinforcers are scores on quizzes and tests and these are impersonal, not immediately translatable into anything tangible, and frequently they are aversive rather than rewarding. Also the response being rewarded is not really the response desired, but an indirect written representation of it.

Thus, a close analysis of each element of the reinforcement paradigm (Fig. 1) demonstrates important advantages for the co-op strategy in each aspect: (1) stimulus configurations are rich and natural rather than abstracted or imagined, (2) a variety of appropriate responses are actively required, and (3) reinforcement contingencies are more potent, meaningful and far more frequent.

The stimulus side of this paradigm deserves some special attention also in this comparison. Typically for classroom consideration the stimulus is a specific stimulus configuration that clearly calls for the appropriate R. But the world is not so simple, and the co-op student has a chance to learn that. He or she learns that there is a range of stimuli which call for the appropriate R. He also learns to be able to discern the correct stimulus from other kinds of interferrence or "noise" stimuli which are typically not presented for classroom examples. Thus, the co-op approach offers several advantages with respect to the Law of Effect.

II. THE LAW OF EXERCISE (Practice)

Thorndike's second law, the Law of Exercise, noted that reinforcement generally causes performance to improve slowly and gradually. He observes that the more often an S—R bond is followed by reinforcement, the stronger the S—R bond becomes —— gradually. The result is observed as the typical Learning Curve (Figure 2). The learning function has been observed almost without exception to be graded, smooth, and gradual.

An important conclusion to be drawn from this principle is that the method of teaching by drill, the rote learning system, is a valid method. And the fact is it does work. But, in the classroom it has drawbacks, and they are pretty obvious. It is a tedious system, that creates an aversive atmosphere, engendering a negative attitude among students for education in general. It is an expensive way to use a teacher, and time consuming for everyone else in the class. It seems pointless, since students can practice on their own. So teachers assign practice and hope for the best, but they have also learned not to be too optimisic that students will really practice on their own.

So, we don't use the classroom for this kind of drill any more. Instead we view the classroom as a good environment for systematically introducing, organizing, and interrelating a range of new concepts to students. Its disadvantage is that these concepts will only be weakly and temporarily learned at that point. Before they are forgotten, and before going on to introduce ever more complex material, the introduced concepts need to be repeatedly employed in a meaningful way and followed by reinforcement. But this need cannot easily and appropriately be met in a classroom environment.

By contrast, the co-op assignment provides extensive opportunities for repetition to build strong associations in a setting where repetition is clearly worthwhile and natural. In a co-op assignment each time a task is performed, it is involved with accomplishing something--a customer is served, a hurt person's pain is relieved, a commodity is produced, or a broken piece of equipment is mended--and hopefully another dollar is earned by the student. By this means repetitive practice can occur in an enjoyable, meaningful, profitable, painless and relatively stress-free environment.

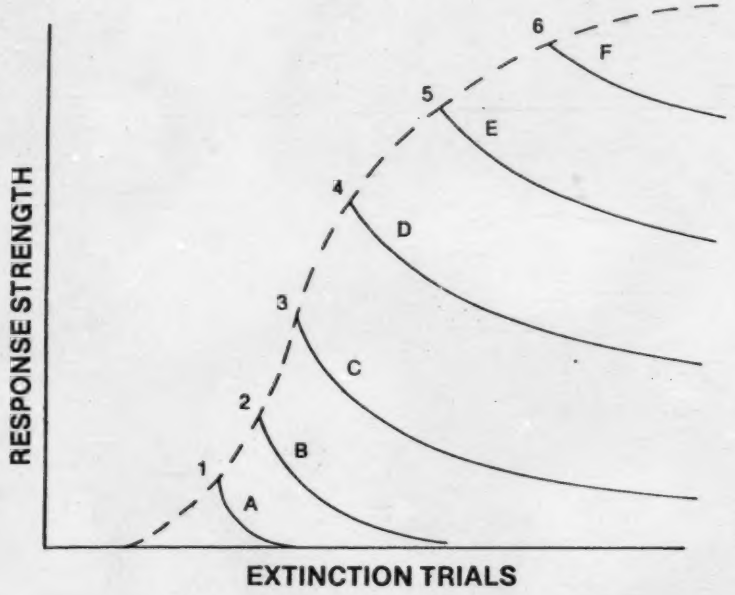
The result of all the additional practice is that the co-op student obtains a benefit from the "overlearning" effect. The overlearning effect is that additional training produces stronger, longer lasting changes in behavior.

Thus, as is shown in Figure 3, if training only extends to a few trials, such as just to points 1 or 2 on the learning curve, then the rate of forgetting, as shown by curves A or B is rapid and quickly approaches zero recall for the task. But if overlearning is provided, and training is continued beyond the initial grasp of how to use a concept, then learning is much more persistent and thorough, and what has been learned can be more quickly recalled. This additional experience is provided by the co-op approach.

In Figure 4 actual data are presented from a human learning experiment which confirm the advantage of overlearning. In this figure 0% overlearning means that reinforced training lasted just to the first point where the subject can perform the desired task, while 50% or 100% overlearning means that subjects got 50% or 100% extra trials, respectively, beyond that point. Then subjects were asked to recall what they had learned, and these data were the recall results over the days following cessation of training. Co-op provides an overlearning benefit, naturally.

FIGURE 3

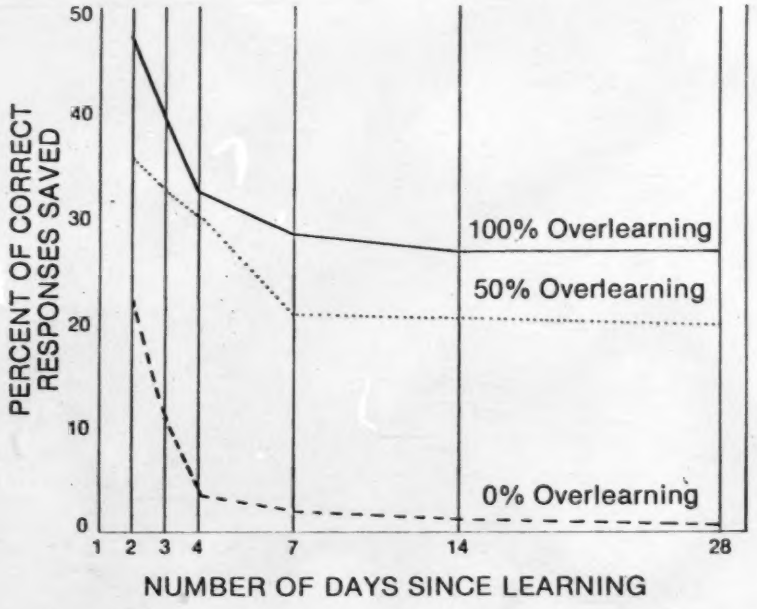
RESISTANCE TO EXTINCTION AS A FUNCTION OF LEVEL OF LEARNING



RESPONSE STRENGH
EXTINCTION TRIALS
A,B,C,D,E,F = Alternative response decay functions (forgetting rates) when extinction is initiated at 1,2,3,4,5, or 6, respectively.

FIGURE 4

RETENTION OF VERBAL LEARNING AS A FUNCTION OF OVERLEARNING



Data from Krueger, W.C.F. *J. Exp. Psychol.*, 1929, *12*, 71-78

III. THE LAW OF READINESS (Attentiveness)

Thorndike's third law was that the subject must be ready, i.e. attentive, in order to receive and respond to the critical stimuli. This law is schematically shown in Figure 5. The effectiveness of a stimulus to hold our attention so that we can respond appropriately, depends on many organismic factors that may momentarily capture our thoughts; such as this morning's breakfast, last night's hot date, the money you dropped on a bad bet last night, or perhaps a puzzling concept introduced by a professor in the middle of his lecture.

Humorous asides or anecdotes always capture students' attention, because human has powerful attention getting capacity. This fact is used effectively to rejuvenate the attention of a class to the speaker, but unfortunately, to the professor's chagrin, attention of the class may only last for the duration of the humorous story. The result of the attentiveness factor is that lectures are always received by the listeners as disconnected segments by each student. But the co-op setting, like other individualized learning situations, lets learning progress and pause in step with the learner's attentiveness. Thus, co-op is a strategy that is well adapted to the Law of Readiness.

IV. THE PRINCIPLE OF STIMULUS ASSOCIATION

Stimuli which frequently occur together with other highly meaningful stimuli become cognitively associated with the latter stimuli. This is the "classical" or "Pavlovian" conditioning process that was first examined by I. P. Pavlov (1927).

Briefly, Pavlov showed that if a neutral "conditioning stimulus" (CS), such as a metronome is coupled with a potent "unconditioned stimulus" (US), such as a squirt of lemon juice or meat powder in a dog's mouth, then the dog will eventually start salivating just to the sound of the metronome alone. The dog learns to associate the innocuous sound of the metronome (CS) with the taste of the more potent stimulus (US). The paradigm for this process is shown in Figure 6.

This process is related to the formation of associations between stimuli and between concepts and ideas entirely on a cognitive level. It suggests to some theorists explanations for concept formation, purposiveness in behavior (Tolman), and "expectancy" formation. Thorndike referred to this process as "associative shifting." By this process many stimuli, through simple experience, come to be associated with other stimuli and to instigate expectancies or to evoke other thoughts. For example, very simple words (e.g. sex, coke, fire, hate), symbols (e.g. a cross, or a swastika), or faces (e.g. Presidents' faces) have the ability

FIGURE 5

LAW OF READINESS (Attentiveness)

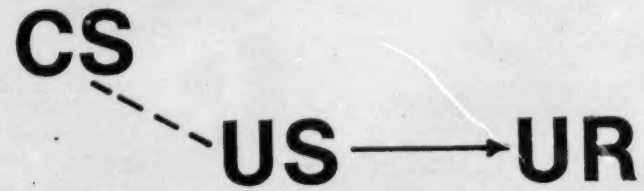
Variables Influencing Organismic State —

Examples:
Satiation
Attentional Distractions
Conflicts
Physiological Factors

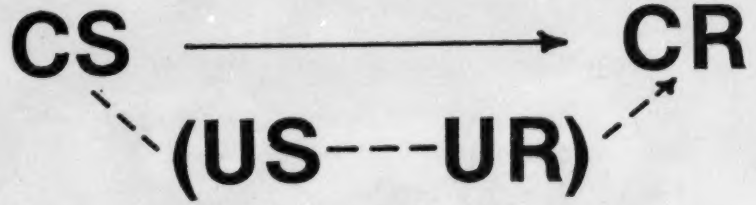
FIGURE 6

PRINCIPLE OF STIMULUS ASSOCIATION OR SUBSTITUTION

1. TRAINING PHASE



2. AFTER TRAINING (CONDITIONING)



CS = Cond. Stimulus
CR = Cond. Response
US = Uncond. Stimulus
UR = Uncond. Response

US = Any "meaningful" Stimulus, UR the "innate" or thoroughly ingrained reaction to US. After conditioning CS "substitutes for", or "is associated (cognitively) with", the US.

to immediately flood one's mind with many associated thoughts, all of which have been acquired over the years by this kind of associative process, based on many experiences, particularly those experiences which have been emotionally laden.

Thus, simple stimuli become complex and take on different aspects of meaning depending on situations and experiences. The ability of simple stimuli to take on additional associated qualities depends upon the potency and meaningfulness of the stimuli with which they are coupled, such as when the associated stimuli are pleasureful, aversive, or otherwise of great importance to the subjects. Learning theorists (Garry and Kingsley, 1970) state that "Being meaningful means that there has been some previous experience with the material and that some associations have been formed with it. In other words meaningful material is already learned to some extent." Thus, since co-op provides experiences that yield associations between concepts and real events or activities, it produces partial learning of those concepts, while it also makes them more meaningful.

Cooperative Education imbues many appropriate stimuli with meaningfulness which can be associated later with others as complex stimuli become elaborated within a discipline. For example, co-op students encounter a vast repertoire of terms which are made meaningful by their use in the co-op setting.

While concept elaboration during the co-op assignment may not achieve a sophisticated level, the meaningfulness that is added to concepts from events and activities during co-op assignments is extensive. This greatly hastens the student's thorough understanding of the concepts themselves. More importantly, these more meaningful concepts can be used, then, in conjunction with other facts to promote grasping of new ideas. Thus co-op can provide the concrete experiences which are necessary to make classroom lectures more understandable. The task for the instructor, to elaborate the concepts and interrelate them, is greatly simplified if related experiences have already occurred, making the concepts more meaningful.

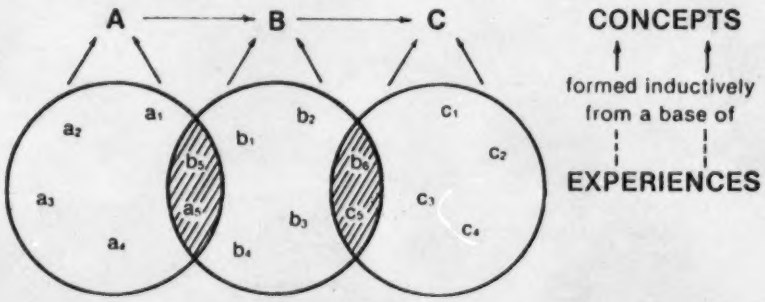
This is illustrated in Figure 7 (I). The three sets of experiences (a, b and c) provide experiential bases for inductively forming the concepts (A, B and C). Furthermore, since the sets overlap it is also easier to make connections between the A, B and C concepts.

By contrast, with a deficient experiential basis as in Figure 7 (II), it is difficult for students to grasp these concepts or to make any connections between them. For a concept where there may be no experiential basis at all (B), the connections between A, B and C becomes particularly difficult. A professor's effort

FIGURE 7

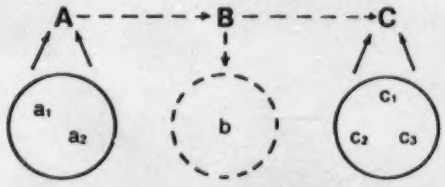
CONCEPT FORMATION AND RELATED ASSOCIATIONS

I. BASED ON RICH EXPERIENCE BASE



OVERLAPPING SETS OF
A, B, AND C TYPE EXPERIENCES

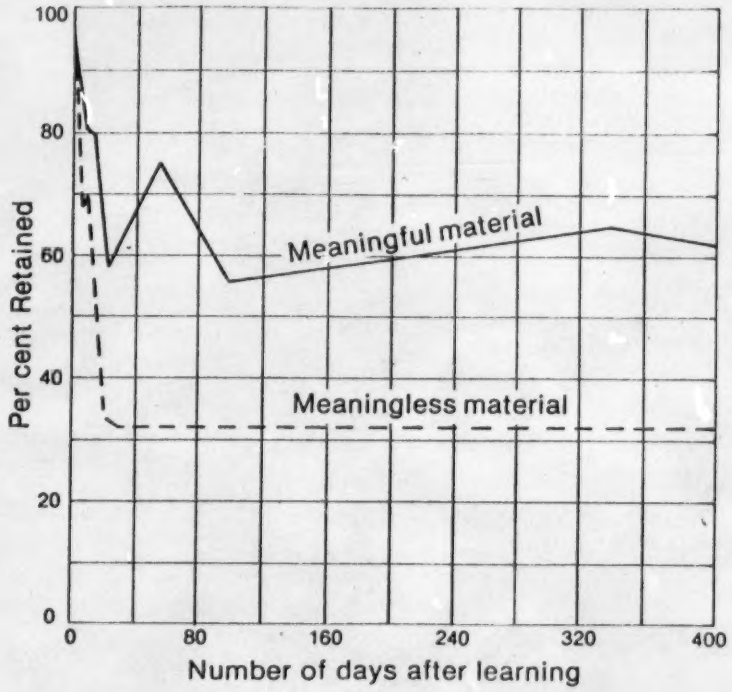
II. BASED ON LIMITED EXPERIENCE PLUS DEDUCTIONS AND EXPLANATIONS



NON-OVERLAPPING SETS OF
LIMITED EXPERIENCES AND
ANECDOTAL OR DEDUCED EXAMPLES

FIGURE 8

RETENTION CURVES FOR MEANINGFUL VS. MEANINGLESS CURVES



Curves are composites of 18 studies of meaningless and 24 studies of meaningful material. (Data from Davis and Moore, 1935; from Davis, 1935.)

to compensate by deductively providing an anecdotal example may be helpful, but it will lack subjective authenticity for the student and will provide a very weak basis for generalizing a concept.

An example of evidence from verbal learning research, shown in Figure 8, confirms the importance of meaningfulness to faciliate more thorough, lasting learning. In lecture situations, if the instructor's terms and concepts have greater meaningfulness for the student, this translates directly into quicker understanding of concepts and assimilation of the lecture material.

In fact, learning research strongly indicates that meaningfulness is particularly important for acquiring new knowledge, rather than being important for retention. Indeed some evidence suggests that concepts probably are not learned at all as general abstractions unless a sizable base of concrete experiences exists. Thus, meaningfulness provided by co-op experience yields greater preparation of students to acquire more sophisticated concepts.

Philosophically, one would say that theory construction in any discipline involves logical abstraction and extension from a matrix of meaningful, concrete facts and experiences. To be able to understand and extend the abstraction inductively, one must have assimilated the underlying concrete references. Cooperative Education provides the opportunity for concepts to be made meaningful and concrete and thus it can promote understanding of related abstractions in subsequent coursework. It is important to make clear that for the educational benefit of the student, co-op experience is at least as valuable to be scheduled as a precursor to related coursework as it is to occur as a subsequent event. This, in fact, is at the heart of the distinction made by Cooperative Education philosophy from other experiential learning programs, which may employ the experiential term(s) only at the end of the academic program.

V. OBSERVATIONAL/IMITATIVE LEARNING PROCESSES (Modeling)

Even without any overt practice or apparent reinforcement humans are noteworthy for their ability to learn simply by observing a model perform a specified behavior pattern. This phenomenon recognizes the ability of humans to mentally manipulate concepts and even to learn during this mental process. This process is briefly outlined in Figure 9.

Learning by Modeling obviously operates both in class and on the co-op job, but what is modeled and what is learned in each setting is different. In the classroom the professor's pedagogic behavior talking about concepts is modeled. In the co-op placement, the behavior of a professional using concepts is modeled.

FIGURE 9

MODELING

ENVIRONMENT/ SITUATION	MODEL	LEARNER
-APPROPRIATE for a specific response (R_1)	1. Performs R_1 2. Earns Reinf. (or progresses toward Reinf.)	1. Observes -Stimulus envt. -R_1 performed -Reinf. earned 2. Mentally -Rehearses R_1 -"Experiences" Reinf. -Develops S-R_1 association
-INAPPROPRIATE for R_1 (for whatever reason)	1. Discriminates that R_1 is not appropriate 2. Selects R_2 3. Performs R_2 4. Earns Reinf.	1. Observes -Different Stim. envt. -Discrimination made -Alternate R performed -Reinf. effects 2. Mentally -Learns appropriate discrimination -"Experiences" same process as above

Other basic learning processes come into effect when Learner employs R_1 or R_2 in subsequent situations. Qualities of the Model are also very important in the process.

There is no doubt that the teacher accurately explains concepts, but professionals at the co-op site need to demonstrate, to model, how to use knowledge. The end result in the latter case is that what is to be learned is converted into a functional mode.

Quite often a student simply needs to observe the broad variety of appropriate situations that call for certain behavioral routines to be performed. Classroom discussion typically presents the desired behavioral routine, abstracted--not modeled, for a narrowly prototypical situation. But in the Co-op setting the student observes models actually performing the routine for the full variety of situations that are appropriate to the behavior. In addition he or she also observes models opting for other behaviors at other times. Thus the co-op student learns through modeling, to a higher level of refinement and can correctly distinguish a far greater range of situations which do or do not call for the specific behavior pattern.

VI. SOME IMPLICATIONS

Cooperative Education has many values for students including career development, affective and social maturation, financial assistance and enhanced self-concept. However, its value as a learning strategy is very great and should be more extensively studied and documented--particularly if broad acceptance of co-op is ever to be achieved in academia. It is clearly founded on potent and fundamental learning processes. Co-op educators need to examine far more extensively the relationships between co-op assignments and learning objectives that are achieved, particularly those co-op positions that enrich the experience of students and promote more rapid grasping of theoretical constructs. It is not enough to preach this message to the converted believers; it is critical to demonstrate this advantage in factual data for the skeptics. Toward this end most co-op programs are placing increasing emphasis on learning objectives, which I believe is good.

The observation that learning grows as a cyclical process of experiencing and testing reality--developing and elaborating theory--and then more experiencing and testing reality clearly implies that co-op assignments should occur early and repeatedly throughout students' schooling. Several factors also indicate that intervals between work periods and study periods should not be too lengthy. Clearly, experiential programs that offer only a senior year internship, while better than programs that offer no experiential component at all, do not truly serve the need for students to gain real understanding and confirmation of what they are learning <u>as they are learning it</u>.

SUMMARY AND RECOMMENDATIONS

Learning research has identified several processes and mechanisms that operate to promote learning. Among these are basic, important learning processes that are far better adapted to the Cooperative Education strategy than any method that leans entirely on classroom instruction:

1. Reinforcement opportunities for appropriate behavior are far more frequent and meaningful for students in co-op assignments.
2. Opportunities to practice behavior patterns are more frequent, more real, and associated with a far greater range of appropriate settings and richer contexts.
3. Overlearning, which greatly aids retention, is a natural aspect of a co-op job, resting on a reasonable purpose for repetition. Consequently, ideas are not merely tenuously grasped but thoroughly ingrained.
4. Co-op settings enjoy the natural advantage of any individualized learning setting in assuring that it progresses and pauses in synchrony with the person s attentiveness.
5. Concrete experiences occur in co-op assignments that provide meaningfulness to concepts so that they can be grasped more quickly and thoroughly.
6. Models on co-op jobs provide extensive demonstrations of appropriate behavior patterns in a variety of real situations that are rewarded or punished appropriately.

Additional examination of learning processes would doubtlessly reveal other important advantages of the co-op method. However, these should suffice to challenge faculty, particularly co-op educators, to explore and develop more fully the relationships between learning objectives on co-op assignments and those of the students' major discipline(s).

In conclusion, the co-op method is a valuable addition to the educational system, helping it to achieve its basic mission, which is to promote learning. We should say so——loudly and frequently——and we also need to improve our methods of proving that this is the case.

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